## Institute Vision

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research and technological service to the National needs.

## Institute Mission

- To educate students at Undergraduate, Post Graduate Doctoral and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching and learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

## Department Vision

To become a centre of excellence in teaching and research for creating technical manpower to meet the technological needs of the country in the field of Electronics and Communications Engineering.

## Department Mission

- To facilitate state of the art Education and Research at Undergraduate, Post Graduate and Doctoral levels to enable to perform challenging engineering and managerial jobs in the field of Electronics and Communication Engineering.
- To build national capabilities in Technology, Education and Research in emerging areas in the field of Electronics and Communication Engineering.
- To create an environment to provide excellent Research and Development facilities to strengthen Ph.D. Programmes and Research Projects.
- To provide excellent Technological Services to bridge the gap between Academics and Industry in order to fulfill the overall academic needs of the society.
- To provide high quality Course Structure in order to turn out qualified professionals to meet the engineering needs of the country.
- To develop effective Teaching Skills and the Research Potentials of the faculty members.
- To ensure All Round Development of the students and to create a platform for turning out engineering professionals who can assume leadership position in society.

## M. Tech. (Wireless Communication)

## PEO (Programme Educational Objectives)

| | |
|---|---|
| PEO1 | To enable students to acquire in-depth knowledge in the field of wireless communication technology with an ability to integrate existing and new knowledge with the advancement of the technology. |
| PEO2 | To develop students to critically analyze the problems in the field of wireless communication technology and find optimal solution. |
| PEO3 | To train students to conduct research and experiments by applying appropriate techniques and tools with an understanding of the limitations for sustainable development of society. |
| PEO4 | To prepare students to act as a member and leader of the team to contribute positively to manage projects efficiently in the field of wireless communication technology. |
| PEO5 | To train students to effectively communicate, write reports, create documentation and make presentations by adhering to appropriate standards. |
| PEO6 | To stimulate students for life-long learning with enthusiasm and commitment to improve knowledge and competence continuously. |

## PROGRAM OUTCOMES (POs)

After completion of the programme, students will be able to demonstrate

| | |
|---|---|
| PO1 | An ability to independently carry out research /investigation and development work to solve practical problems. |
| PO2 | An ability to write and present a substantial technical report/document. |
| PO3 | A degree of mastery in wireless communication technology at a level higher than the requirements in the appropriate bachelor program. |
| PO4 | An ability to create, select and apply appropriate techniques and tools to undertake activities in the field of wireless communication technology with an understanding of the limitations. |
| PO5 | Professional and intellectual integrity, professional code of conduct, ethics of research with an understanding of responsibility to contribute in the field of wireless communication technology for sustainable development of society. |
| PO6 | Understanding of engineering with management principles to apply the same as a member and leader in a team to manage projects efficiently in the field of wireless communication technology. |

# COURSE INFORMATION SHEET

**Course code: EC510**
**Course title: Wireless Communication and Networks**
**Pre-requisite(s): EC 369, EC 327**
**Co- requisite(s): Nil**
**Credits: L:3 T:0 P:0**
**Class schedule per week: 03**
**Class: M. Tech.**
**Semester / Level: I/05**
**Branch: ECE**

**Course Objectives:**

This course aims to develop

| | |
|---|---|
| 1 | An understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards. |
| 2 | An ability to compare recent technologies used for wireless communication. |
| 3 | An ability to explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks. |
| 4 | An ability to explain multiple access techniques for Wireless Communication |
| 5 | An ability to evaluate design challenges, constraints and security issues associated with Ad-hoc wireless networks. |

## Course Outcomes

On the completion of this course, the students will be able to:

| | |
|---|---|
| CO1 | Demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards. |
| CO2 | Compare different technologies used for wireless communication systems. |
| CO3 | Explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks. |
| CO4 | Demonstrate an ability explain multiple access techniques for Wireless Communication |
| CO5 | Demonstrate an ability to evaluate design challenges, constraints and security issues associated with Ad-hoc wireless networks. |

**Syllabus**

**Module1:** Overview of wireless communication, cellular communication, different generations and standards in cellular communication system, satellite communication including GPS, wireless local loop, cordless phone, paging systems, RFID. (8)

**Module 2:** Recent wireless technologies: multicarrier modulation, OFDM, MIMO system, diversity-multiplexing trade-off, MIMO-OFDM system, smart-antenna; beamforming and MIMO, cognitive radio, software defined radio, communication relays, spectrum sharing. (8)

**Module 3:** Multiple access techniques in wireless communication: contention-free multiple access schemes (FDMA TDMA, CDMA, SDMA and Hybrid), contention-based multiple access schemes (ALOHA and CSMA). (8)

**Module 4:** Wireless personal area networks (Bluetooth, UWB and ZigBee), wireless local area networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), wireless metropolitan area networks (WiMAX). (8)

**Module 5:** Ad-hoc wireless networks: Design Challenges in Ad-hoc wireless networks, concept of cross layer design, security in wireless networks, energy constrained networks. MANET and WSN. Wireless system protocols : mobile network layer protocol (mobile IP, IPv6, dynamic host configuration

protocol), mobile transport layer protocol (traditional TCP, classical TCP improvements), support for mobility (wireless application protocol). (8)

**Text Books:**


1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
2. Sanjay Kumar, "Wireless Communication the Fundamental and Advanced Concepts" River Publishers, Denmark, 2015 (Indian reprint).


**Reference Books:**


1. Vijay K Garg, "Wireless Communications and Networks", Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint)
2. J. Schiller, "Mobile Communication" 2/e, Pearson Education, 2012.
3. Iti Saha Misra, "Wireless Communication and Networks : 3G and Beyond", 2/e, McGraw Hill Education (india) Private Ltd, New Delhi, 2013.


**Course Evaluation:** Individual assignment, Theory (Quiz and End semester) examinations

**Gaps in the syllabus (to meet Industry/Profession requirements) :** Nil

**POs met through Gaps in the Syllabus:** N/A

**Topics beyond syllabus/Advanced topics/Design:** Current technological developments in wireless communication systems.

**POs met through Topics beyond syllabus/Advanced topics/Design:** PO3

## Course Delivery Methods

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

**MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 3 | 3 | 2 | 1 |
| CO2 | 1 | 1 | 3 | 2 | 2 | 1 |
| CO3 | 2 | 2 | 3 | 3 | 1 | 1 |
| CO4 | 2 | 1 | 3 | 3 | 1 | 1 |
| CO5 | 3 | 2 | 3 | 3 | 1 | 1 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

**MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD**

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD2,CD6 |
| CO2 | CD1, CD2, CD6 |
| CO3 | CD1, CD2, CD6 |
| CO4 | CD1, CD2, CD6 |
| CO5 | CD1,CD2,CD3, CD7 |

# COURSE INFORMATION SHEET

**Course code: EC 512**
**Course title: Stochastic Processes and Information Theory**
**Pre-requisite(s): EC324**
**Co- requisite(s):**
**Credits: L: 3 T: 0 P: 0**
**Class schedule per week: 3**
**Class: M.Tech**
**Semester / Level: 01**
**Branch: ECE**

**Course Objectives**

Information Theory answers two fundamental questions: what is the maximum data rate at which we can transmit over a communication link, and what is the fundamental limit of data compression. In this course we will explore answers to these two questions. We will study some practice source compression algorithms. We will also study how to compute channel capacity of simple channels.

This course enables the students:

| | |
|---|---|
| 1 | To conceptualize random variable and stochastic process with real time examples. |
| 2 | To impart fundamental knowledge of information theory and several source coding techniques for efficient representation. |
| 3 | To understand channel capacity and coding techniques to achieve efficient as well as reliable communication. |
| 4 | To Measure information in diverse areas of Electronics communication Engineering. |
| 5 | Demonstrate an ability to evaluate design challenges and constraints issues associated with measurement of information transfer rate for numerous applications. |

**Course Outcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Apply the concept of probability theory and stochastic process to understand the Basics of information theory. |
| CO2 | Measure information from a discrete as well as continuous source and evaluate entropy under several conditions. |
| CO3 | Compute the capacity of discrete and continuous time channels in presence and absence of noise. |
| CO4 | Select practical solutions to complex communication engineering problems with information theoretic view. |
| CO5 | Demonstrate an ability to evaluate design challenges and constraints issues associated with measurement of information transfer rate for numerous applications. |

**Syllabus:**

**Module 1:** Random processes: stationarity; mean, correlation, and covariance functions, WSS random process; autocorrelation and cross-correlation functions; transmission of a random process through a linear filter; power spectral density; white random process; Gaussian process; Poisson process. (8)

**Module 2:** Introduction to Information theory: Entropy, Relative Entropy, Mutual Information; Asymptotic Equipartition Property; Entropy rates of a stochastic process, Differential entropy; Source coding: Kraft's inequality; Huffman coding; Arithmetic codes & Lempel-Ziv codes, Coding for sources with memory. (8)

**Module 3:** Channel Capacity and coding: Noisy channel coding theorem; Converse of noisy channel coding theorem; Channel capacity of discrete memory less channels; Gaussian Channel; Parallel Gaussian Channel. (8)

**Module 4:** Rate Distortion Theory: Calculation of rate- distortion function (Binary Source, Gaussian Source); Converse to the rate- distortion function; Computation of channel capacity and the rate distortion function. (8)

**Module 5:** Network Information Theory: Gaussian Multiple-User Channels, Multiple access channel, Encoding of correlated sources, Broad cast channel, Relay channel, Source coding with side information and Multi-terminal Networks. (8)

**Text Books:**


1. Thomas M. Cover, Joy A. Thomas, "Elements of Information Theory", 2nd Edition, John Wiley & Sons, 2006.
2. Robert G. Gallager, "Information Theory and Reliable Communications", John Wiley & Sons, 1968.


**Course Evaluation:** Individual assignment, Theory (Quiz and End semester) examinations

**Gaps in the syllabus (to meet Industry/Profession requirements) :** Nil

**POs met through Gaps in the Syllabus:** N/A

**Topics beyond syllabus/Advanced topics/Design:** Current technological developments in stochastic processes.

**POs met through Topics beyond syllabus/Advanced topics/Design:** PO3

## Course Delivery Methods

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

## MAPPING OF COURSE OUTCOMES ONTO PROGRAM OUTCOMES

| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 3 | 2 |
| CO4 | 2 | 3 | 3 | 3 | 2 | 2 |
| CO5 | 3 | 2 | 3 | 3 | 1 | 1 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

## MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD2,CD6 |
| CO2 | CD1, CD2, CD6 |
| CO3 | CD1, CD2, CD6 |
| CO4 | CD1, CD2, CD6 |
| CO5 | CD1,CD2,CD3, CD7 |

# COURSE INFORMATION SHEET

**Course code: EC503**
**Course title: Antennas and Diversity**
**Pre-requisite(s): EC257 Electromagnetic Fields and Waves, EC323 Microwave Theory &Techniques**
**Co- requisite(s): Nil**
**Credits: L:3 T:0 P:0**
**Class schedule per week: 03**
**Class: M. Tech.**
**Semester / Level: I/05**
**Branch: ECE (Microwave Engineering / Wireless Communication)**

**Course Objectives:**

This course enables the students to:

| | |
|---|---|
| 1. | Develop and apply the mathematical tools to analyze radiation characteristics of aperture antennas. |
| 2. | Design and analyse various broadband, high gain, planar antennas for wireless applications. |
| 3. | Design and analyse the dielectric resonator antenna |
| 4. | Understand the concept of ,smart antenna and beam forming techniques by using cellular radio system and its evolution |
| 5. | Explain the need of different diversity schemes used in wireless communication |

**Course Outcomes:**

At the end of the course, a student should be able to:

| | |
|---|---|
| CO1 | Understand the concept of aperture antennas, dielectric resonator antennas and their applications |
| CO2 | Develop the mathematical tool to analyze radiation characteristics of antennas for wireless applications |
| CO3 | Design the various types of aperture ,dielectric resonator antennas to evaluate its performance |
| CO4 | Explain and compare different diversity scheme , smart antennas and algorithms. |
| CO5 | Combine different diversity scheme to enhance system performance |

**Syllabus**

**Module I:** Aperture Antennas**:** Radiation Equations, Rectangular Apertures: Uniform Distribution on an infinite ground plane, Uniform distribution in Space, Circular Apertures: Uniform Distribution on an infinite ground plane, Design Considerations**. (**8L**)**

**Module II:** Antennas for Wireless Communication: Helical, Normal mode, Axial mode, Design procedure, feed design for helical antenna, Horn Antenna; E-Plane, H-Plane, Pyramidal horn, Whip antenna, Discone antenna, (8L)

**Module III:** Dielectric Resonator Antenna: Introduction to Dielectric Resonator Antennas. Major Characteristics, Simple-Shaped Dielectric Resonator Antennas - The Hemispherical DRA. The Cylindrical DRA. The Rectangular DRA, Coupling to DRAs, Hybrid DRAs Bandwidth Enhancement of DRAs, Low Profile and Compact DRAs, DRAs with High Dielectric Constants, Circular-Polarized and Dual-Polarized DRAs, Ferrite Resonator Antennas. (8L)

**Module IV:** Smart Antenna: Introduction, Cellular Radio Systems Evolution, Signal propagation, Diversity and Combining Techniques, Smart Antenna System, Benefits and drawbacks of Smart Antennas, Antenna beamforming**.** (8L)

**Module V:** Diversity Schemes: Macroscopic diversity scheme, Microscopic diversity scheme – Space diversity, Field diversity, Polarization diversity, Angle diversity, Frequency diversity and time

diversity scheme. Combining techniques for Macroscopic diversity, Combining techniques for Microscopic diversity. (8L)

**Text Books**

1. Antenna Theory , Analysis and Design, 3/E, . A. Balanis, John Wiley.
2. Antennas, J. D. Kraus, TMH
3. Wireless Communications, Principles and Practices, Rappaport, PHI

**Reference Books**

1. Software Radio A Modern Approach to Radio Engineering, J. H. Reed, Pearson Education.
2. Wireless and Cellular Communications, William C. Y. Lee, McGraw-Hill
3. Wireless Communications, Principles and Practices, Rappaport, PHI
4. Smart Antenna, T. K. Sarkar

**Course Evaluation:** Individual assignment, Theory (Quiz and End semester) examinations

**Gaps in the syllabus (to meet Industry/Profession requirements) :** Design and Development of real-time industrial projects.

**POs met through Gaps in the Syllabus**:PO4 & PO5

**Topics beyond syllabus/Advanced topics/Design:** Design optimization for industrial and Research projects,

**POs met through Topics beyond syllabus/Advanced topics/Design**: PO4 & PO5

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

**MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | -- | 1 | 3 | -- | -- |
| CO2 | 3 | 2 | 1 | 3 | -- | 1 |
| CO3 | 3 | 1 | 2 | 3 | 2 | 1 |
| CO4 | 3 | 2 | 2 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

**MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD**

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD6 |
| CO2 | CD1, CD2,CD3,CD7 |
| CO3 | CD1, CD2, CD3,CD6,CD7 |
| CO4 | CD1, CD3,CD6,CD7 |
| CO5 | CD1,CD2,CD3,CD4,CD5,CD7 |

*Programme Electives*

# COURSE INFORMATION SHEET

**Course code: EC513**
**Course title: Spread Spectrum Techniques and Multiple Access**
**Pre-requisite(s): EC 510, EC 301**
**Co- requisite(s): Nil**
**Credits: L:3 T:0 P:0**
**Class schedule per week: 03**
**Class: M.Tech.**
**Semester / Level: I/05**
**Branch: ECE**

**Course Objectives:**

This course aims to develop

| | |
|---|---|
| 1 | An understanding of spread-spectrum concept and its implementation in various systems. |
| 2 | An ability to understand binary sequences and its generation. |
| 3 | An ability to evaluate performance of various Spread–Spectrum Systems in Jamming Environments |
| 4 | An ability to design and provide solutions for practical and efficient system and Multiple Access Techniques. |
| 5 | An ability to explain various types of cdma standards and multi user detection. |

**Course Outcomes**

On the completion of this course, the students will be able to:

| | |
|---|---|
| CO1 | Demonstrate their understanding on functioning of a spread-spectrum system and minimize the design challenges. |
| CO2 | Have an ability to demonstrate several pseudo random sequences and its applications. |
| CO3 | To design a broadband spread –spectrum under in Jamming Environments. |
| CO4 | Demonstrate an ability to explain various multiple access techniques, |
| CO5 | Have an ability to provide practical solutions and apply the subject expertise for the welfare o the society. |

**Syllabus**

**Module -1:** Introduction to Spread-Spectrum Systems: Direct-sequence Spread−Spectrum for BPSK, QPSK, MSK, Frequency-Hop Spread Spectrum: Coherent and Non-coherent, Hybrid Direct−Sequence/ Frequency−Hop Spread Spectrum. (8)

**Module -2:** Binary Shift – Register Sequences for Spread- Spectrum Systems: Definitions, Finite field Arithmetic, Sequence Generator fundamentals, State –Machine Representation of Shift Register Generators, Maximal length - Sequences, Gold codes, orthogonal codes, Walsh codes. (8)

**Module -3:** Performance of Spread–Spectrum Systems in Jamming Environments: AWGN jamming, Partial – band jamming, pulsed noise jamming, single tone jamming, multiple - tone jamming. (8)

**Module -4:** Multiple Access Techniques: Frequency Division Multiple Access, Time Division Multiple Access, Code Division Multiple Access, Space Division Multiple Access and Orthogonal Frequency Division Multiple Access, ALOHA, Slotted ALOHA, Carrier Sense Multiple Access, Packet Reservation Multiple Access, Busy Tone Multiple Access, Digital Sense Multiple Access. (8)

**Module -5:** Specific Application of CDMA Digital cellular Systems: cdma one, cdma 2000 and WCDMA: Carrier Spacing & Deployment Scenarios, Logical & Physical Channels, Hand over, Spread Spectrum Receivers: RAKE Receiver, Multiuser Detection (MUD). (8)

**Text Book:**

1. Introduction to Spread Spectrum Communications: Roger L. Peterson, R. E. Ziemer, David E. Borth, Pearson Education.

**Reference Books:**

1. Wideband CDMA for Third Generation Mobile Communications-T. Ojanpera & R. Prasad, Artech House, 1992
2. Wireless Communication –Principles & Practice – T.S.Rappaport, Pearson Edu., 2002.
3. Cellular Mobile Systems Engineering-S. Faruque, Artech House, 1996.

**Course Evaluation:** Individual assignment, Theory (Quiz and End semester) examinations

**Gaps in the syllabus (to meet Industry/Profession requirements) :** Nil

**POs met through Gaps in the Syllabus:** N/A

**Topics beyond syllabus/Advanced topics/Design:** Current technological developments in spread spectrum techniques.

**POs met through Topics beyond syllabus/Advanced topics/Design:** PO3

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

## MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 3 | 3 | 1 | 1 |
| CO2 | 1 | 1 | 2 | 1 | 1 | 1 |
| CO3 | 2 | 1 | 3 | 2 | 1 | 1 |
| CO4 | 1 | 1 | 3 | 2 | 1 | 1 |
| CO5 | 3 | 2 | 3 | 2 | 1 | 1 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

## MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD2,CD6 |
| CO2 | CD1, CD2, CD6 |
| CO3 | CD1, CD2, CD6 |
| CO4 | CD1, CD2, CD6 |
| CO5 | CD1,CD2,CD3, CD7 |

# COURSE INFORMATION SHEET

**Course code: EC522**
**Course title: Advanced Digital Signal Processing**
**Pre-requisite(s): B.E. /B. Tech. in ECE/EEE with basic courses on Digital Signal Processing**
**Co- requisite(s): Linear Algebra**
**Credits: L: 3 T:0 P:0**
**Class schedule per week: 03**
**Class: M.Tech.**
**Semester / Level: I/05**
**Branch: Electronics and Communication engineering**

**Course Objectives:**

This course enables the students to:

| | |
|---|---|
| 1 | To understand the concept of signals and systems and filters. |
| 2 | To impart knowledge on various transformation techniques. |
| 3 | To impart knowledge on multirate signal processing and its applications. |
| 4 | An understanding on optimum linear filters and power spectral estimation. |
| 5 | Enhance skills to apply the filter design and spectral estimation in various applications. |

**Course Outcomes:**

At the end of the course, a student should be able to:

| | |
|---|---|
| CO1 | Develop an understanding to concept of signals and systems and to design filters. |
| CO2 | Have an ability to analyze and apply various single and multi-domain transformation techniques. |
| CO3 | Have an ability to apply multirate signal processing on various engineering applications. |
| CO4 | Develop an ability to apply use optimum linear filters and power spectral estimation. |
| CO5 | Aspire for pursuing a carrier in signal processing, robotics and IOT, recognize the need to learn and adapt to the change in technology and play role of team leader or supporter of team. |

**Syllabus**

**Module I:** Review of Signals and Systems, Sampling and data reconstruction processes, Z transforms. Chirp Z Algorithm, Goertzel's Algorithm, Discrete linear systems, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters,IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures.(8L)

**Module II:** DSP Transforms: Fourier transform, Discrete sine and cosine transform, Discrete Hartely transform, short time Fourier transform, wavelet transform, Hilbert transform, Hilbert-Huang transform, Stockwell transform. (8L)

**Module III:** Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Multi resolution signal analysis, wavelet decomposition, Applications in subband coding.(8L)

**Module IV:** Linear prediction and Optimum Linear Filters: Random signals and power spectra, Forward and backward Linear prediction, solutions of the normal equations, AR lattice and ARMA lattice-ladder filters, Wiener filters. (8L)

**Module V:** Power spectrum estimation: Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigenanalysis Algorithms for Spectrum Estimation (8L)

**Text Books**


4. J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007. (**T1)**
5. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
6. S. Haykin and T. Kailath, Adaptive Filter Theory, Pearson Education, 4th Edition, 2005.


**Reference Books**


1. Digital Signal Processing 3/E by S.K.Mitra TMH Edition.
2. Fundamentals of adaptive filtering, A. H. Sayed, Wiley, 2003.
3. Monson H. Hayes, Statistical Digital Signal Processing and Modelling, Wiley, 2002


**Course Evaluation:** Individual assignment, Theory (Quiz and End semester) examinations

**Gaps in the syllabus (to meet Industry/Profession requirements)** : Design of real-time industrial projects.

**POs met through Gaps in the Syllabus:** PO5 & PO6

**Topics beyond syllabus/Advanced topics/Design:** Design optimization for industrial projects, Adaptive systems.

**POs met through Topics beyond syllabus/Advanced topics/Design:** PO5 & PO6

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

## MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | 2 | 2 | 1 | 1 |
| CO2 | 2 | 2 | 2 | 2 | 1 | 1 |
| CO3 | 2 | 2 | 2 | 2 | 1 | 1 |
| CO4 | 2 | 2 | 2 | 2 | 1 | 1 |
| CO5 | 1 | 1 | 2 | 3 | 3 | 3 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

## MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD6, CD2 |
| CO2 | CD1, CD6,CD7, CD2 |
| CO3 | CD1, CD2, CD3,CD6,CD7 |
| CO4 | CD1, CD3,CD6,CD7 |
| CO5 | CD1,CD2,CD3,CD4,CD5 |

# COURSE INFORMATION SHEET

**Course code: EC515**
**Course title: Wireless Adhoc and Sensor Networks**
**Pre-requisite(s): EC 510, EC 353**
**Co- requisite(s): Nil**
**Credits: L:3 T:0 P:0**
**Class schedule per week: 03**
**Class: M.Tech.**
**Semester / Level: I/05**
**Branch: ECE**

**Course Objectives:**

This course aims to develop

| | |
|---|---|
| 1 | An understanding of the concept of wireless adhoc and wireless sensor network with its major challenges. |
| 2 | An understanding of WSN architecture and its design principles. |
| 3 | Fundamental understanding on MAC and routing protocols. |
| 4 | An ability to evaluate Localization And Positioning techniques in wireless adhoc and wireless senso network. |
| 5 | An ability to design and provide solutions for practical low cost, energy efficient, reliable and secure wireless sensor network. |

**Course Outcomes**

On the completion of this course, the students will be able to:

| | |
|---|---|
| CO1 | Have an ability to evaluate wireless adhoc & sensor network based on its performance as well as minimize the design challenges. |
| CO2 | Have an ability to demonstrate several architectures of WSN and provide a new design solutions according to the required applications. |
| CO3 | Have an ability to design several MAC, Routing and transport protocols for WSNs. |
| CO4 | Have an ability to provide practical solutions and apply the subject expertise for the welfare of society. |
| CO5 | Demonstrate several Localization & Positioning techniques in wireless adhoc & sensor network. |

**Syllabus**

**MODULE I:** Introduction To Wireless Ad Hoc And Sensor Networks :Fundamentals of Wireless Communication Technology, The Electromagnetic Spectrum, Radio propagation Mechanisms, Characteristics of the Wireless Channel, mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs) :concepts and architectures, Applications of Ad Hoc and Sensor networks, Design Challenges in Ad hoc and Sensor Networks. (8)

**MODULE II:** Single Node And Network Architecture**:** single node architecture: hardware and software components of a sensor node , WSN Network Architecture: typical network architectures-data relaying and aggregation strategies, Energy consumption of sensor nodes, Operating system and execution environments, sensor network scenarios, Optimization goals and figures of merit, Design principles of WSNs. (8)

**MODULE III:** Mac Protocols For Wireless Sensor Networks **:** Fundamental of MAC protocols, MAC protocols for WSNs, Low duty cycle protocols and wakeup concepts, contention based and scheduled based protocols (LEACH, SMACS, TRAMA), IEEE 802.15.4 MAC protocols, Topology control and clustering. (8)

**MODULE IV:** Routing Protocols And Transport Control Protocols For WSN : Routing challenges and design issues in WSNs, Wireless network routing protocols, Energy efficient unicast routing,

energy efficient broadcast /multicast routing, Geographical routing, traditional transport control protocols, Design issues of transport control protocols, CODA, ESRT, RMST, PSFQ, GRAUDA and Ad hoc Transport protocols (ATP) . (8)

**MODULE V:** Localization And Positioning: Properties of localization and positioning procedures, Possible approaches: Proximity, Trilateration and Triangulation, Mathematical basics for the lateration problem, single hop localization, positioning in multi-hop environment. (8)

**Text Books:**

1. Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks', John Wiley & Sons Inc. Publication, 2007(8)
2. Holger Karl, and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks" John Wiley & Sons Inc. Publication.

**Reference Books:**

3. XiangYang Li, "Wireless Adhoc and Sensor Networks: Theory and Applications", Cambridge university press, USA, 2008.

**Course Evaluation:** Individual assignment, Theory (Quiz and End semester) examinations

**Gaps in the syllabus (to meet Industry/Profession requirements) :** Nil

**POs met through Gaps in the Syllabus:** N/A

**Topics beyond syllabus/Advanced topics/Design:** Current technological developments of sensor networks in emerging applications.

**POs met through Topics beyond syllabus/Advanced topics/Design:** PO3

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

**MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 2 | 2 | 2 | 1 |
| CO2 | 1 | 1 | 3 | 2 | 1 | 1 |
| CO3 | 1 | 2 | 2 | 3 | 1 | 1 |
| CO4 | 2 | 1 | 1 | 3 | 1 | 1 |
| CO5 | 1 | 1 | 2 | 3 | 1 | 1 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

**MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD**

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD2,CD6 |
| CO2 | CD1, CD2, CD6 |
| CO3 | CD1, CD2, CD6 |
| CO4 | CD1, CD2, CD6 |
| CO5 | CD1,CD2,CD3, CD7 |

# COURSE INFORMATION SHEET

**Course code: EC516**
**Course title: Wireless Multimedia Communication**
**Pre-requisite(s): EC 431**
**Co- requisite(s): Nil**
**Credits: L:3 T:0 P:0**
**Class schedule per week: 03**
**Class: M.Tech.**
**Semester / Level: I/05**
**Branch: ECE**

**Course Objectives:**

This course aims to develop

| | |
|---|---|
| 1 | An understanding of the fundamental concept of multimedia communication and its type. |
| 2 | An understanding of multimedia processing in wireless communications, its challenges and multimedia processors. |
| 3 | An understanding, how to efficiently represent multimedia data and how to deliver them over a variety of networks. Also able to understand distributed multimedia system and multimedia conferencing standards. |
| 4 | An understanding of state-of-the-art multimedia coding standards, including MPEG-x, H.26x, and scalable video coding (SVC). |
| 5 | An ability to design and provide solutions for practical robust, energy efficient, reliable and secure multimedia communication system. |

**Course Outcomes**

On the completion of this course, the students will be able to:

| | |
|---|---|
| CO1 | Have an ability to explain a wireless multimedia communication system and its design challenges. |
| CO2 | Demonstrate multimedia processing and various multimedia processors. |
| CO3 | Have an ability to demonstrate several multimedia standards and provide a new design solutions according to the target applications. |
| CO4 | To design a video codec system for sending multimedia over the Internet and wireless networks, where video adaptation, error resilience, error concealment, and quality of servic are also considered. |
| CO5 | Have an ability to provide practical solutions and apply the subject expertise for the welfare of the society. |

**Syllabus:**

**Module I:** Introduction: Multimedia communication through wired and wireless channels: An Introduction, multimedia sources, applications of multimedia networks, Audio-Visual Integration: Media interaction, Audio-to-Visual mapping, Joint audio-video coding. (8)

**Module II:** Multimedia processing in wireless communications**:** Challenges of multimedia information processing for wireless channels, Image & video coding, Signal processing for networked multimedia, NNs for multimedia processing, Multimedia processors. (8)

**Module III:** Distributed multimedia system and Multimedia conferencing standards**:** Main features of a distributed multimedia system, Resource management of distributed multimedia system and networking, Multimedia operating systems, Multimedia conferencing standards: H.320, H.323. (8)

**Module IV:** Multimedia communication standards: MPEG approach to standardization, MPEG-1, MPEG-2, MPEG-4, H.261 standard, H.264 standard, Scalable video coding, Multimedia multiplex and Synchronization. (8)

**Module V:** Multimedia communications across wired and wireless networks: Packet audio/video in the network environment, Video transport across generic networks, Multimedia transport across IP network, Multimedia across wireless. (8)

**Text Books:**

1. Multimedia Communication Systems: Techniques, Standards, and Networks by K.R.Rao, Zoran S. Bojkovic, and D.A. Milovanovic. Pearson Education Asia, 2002.
2. Compressed Video over Networks, edited by Ming-Ting Sun and Amy R. Reibman, Marcel Dekker Inc., Switzerland, 2000.

**Reference Book:**

1. Multimedia over IP and Wireless Networks: Compression, networking, and Systems, by Mihaela van der Schaar. And Philip Chou, Academic Press, 2007.

**Course Evaluation:** Individual assignment, Theory (Quiz and End semester) examinations

**Gaps in the syllabus (to meet Industry/Profession requirements) :** Nil

**POs met through Gaps in the Syllabus:** N/A

**Topics beyond syllabus/Advanced topics/Design:** Current technological developments in wireless multimedia communication.

**POs met through Topics beyond syllabus/Advanced topics/Design:** PO3

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

## MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO2** | 1 | 2 | 3 | 2 | 1 | 1 |
| **CO3** | 1 | 2 | 3 | 3 | 1 | 1 |
| **CO4** | 2 | 1 | 1 | 3 | 1 | 1 |
| **CO5** | 1 | 1 | 2 | 3 | 1 | 1 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

## MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD2,CD6 |
| CO2 | CD1, CD2, CD6 |
| CO3 | CD1, CD2, CD6 |
| CO4 | CD1, CD2, CD6 |
| CO5 | CD1,CD2,CD3, CD7 |

# COURSE INFORMATION SHEET

**Course Code: EC 517**
**Course title: Satellite Based Wireless Communication**
**Pre-requisite(s): EC357, EC 419**
**Co-requisite(s): Nil**
**Credits: L: 3 T: 0 P: 0**
**Class schedule per week: 03**
**Class: M.Tech.**
**Semester / Level: I/05**
**Branch: ECE**

**Course Objectives**

This course aims to

| | |
|---|---|
| 1 | An understanding on Satellite communication system, satellite sub system and earth station. |
| 2 | An ability to evaluate the impact of interference on the satellite communication and complete link design. |
| 3 | An ability to analyze different system parameters, causes of impairments in satellite communication system |
| 4 | An understanding of Multiple access techniques to support satellite communication and special satellite systems |
| 5 | Appreciate the contribution of satellite communication to the overall technological growth by providing understanding on its various useful applications. |

**Course Outcomes:**

On the completion of this course, the students will be able to:

| | |
|---|---|
| CO1 | Demonstrate an understanding on orbital and functional principles of satellite Communication, Satellite sub system and Earth station system. |
| CO2 | Architect, Interpret and select appropriate technologies for implementation of specified satellite communication systems. |
| CO3 | Analyze and evaluate a satellite link and suggest enhancements to improve the link performance |
| CO4 | Demonstrate an understanding of advancement and multiple access techniques to support satellite communication. And various satellite systems |
| CO5 | Demonstrate an understanding of satellite communication for various applications |

**Syllabus**

**Module I :** Origin, History, Current Technology and Overview of Satellite Communication Sytem, Satellite Orbits, Kepler's law, Orbital Mechanics and Orbital Elements, Azimuth and Elevation, Coverage Angle and Slant Range, Look angle determination, Eclipse effect, Sun transit outage, Placement of a satellite in a geostationary orbit, Station keeping and Stabilization. (8)

**Module II ;** Basic Radio Transmission Theory, Uplink and Downlink Design, Design of Satellite Links for Specified Carrier-to-Noise plus Interference Ratio, Noise figure and Noise temperature. Absorbitive Attenuation Noise by Atmospheric Gases, Rain Attenuation, Noise due to Rain, Rain Depolarization, Tropospheric Multipath and Scintillation Effects. Interference Analysis, Interference to and from Adjacent Satellite Systems, Terrestrial Interference, Cross-polarization Interference, Intermodulation Interference. (8)

**Module III :** Frequency Division Multiple Access-SCPC, MCPC. Time Division Multiple Access-random (ALOHA, S-ALOHA) and time synchronized access. Code Division Multiple Access-Fixed and On-demand Assignment. (8)

**Module IV:** Advantages and Disadvantages of Multibeam Satellites, Interconnection by Transponder Hopping, Interconnection by On-board Switching, Interconnection by Beam Scanning, On-Board Processing, Intersatellite Links. (8)

**Module V:** Fixed Point Satellite Network, INTELSAT, Mobile Satellite Network, INMARSAT, Low Earth Orbit and Medium Earth Orbit Satellite Systems, Very Small Aperture Terminal (VSAT) Network, Direct Broadcast Satellite Systems, Global Positioning System. (8)

**Text Books:**

1. Digital Satellite Communications, 2/e, McGraw-Hill, 1990.Tri T. Ha

**Reference Books:**

1. Satellite Communications, John Willey and Sons, 2000T. Pratt, C.W. Bostian
2. Satellite Communications Systems Engineering, Pearson Education, 2/e; 2003 W.L. Prichard, H.G. Suyderhoud and R.A. Nelson

**Course Evaluation:** Individual assignment, Theory (Quiz and End semester) examinations

**Gaps in the syllabus (to meet Industry/Profession requirements):** Nil

**POs met through Gaps in the Syllabus:** NA

**Topics beyond syllabus/Advanced topics/Design:** Design aspects of various component of analog communication system.

**POs met through Topics beyond syllabus/Advanced topics/Design:** PO2

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

## MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

| | Program Outcomes | | | | | |
|---|---|---|---|---|---|---|
| Course Outcome # | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
| CO1 | 3 | 2 | 2 | 1 | - | - |
| CO2 | 3 | 3 | 3 | 3 | 2 | - |
| CO3 | 3 | 3 | 3 | 3 | 2 | - |
| CO4 | 3 | 3 | 3 | 3 | 3 | - |
| CO5 | 3 | 3 | 3 | 3 | 3 | - |

**< 34% = 1, 34-66% = 2, > 66% = 3**

## MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1, CD2, CD3, CD6 |
| CO2 | CD1, CD2, CD3, CD6, CD7 |
| CO3 | CD1, CD2, CD3, CD6, CD7 |
| CO4 | CD1, CD2, CD3, CD6, CD7 |
| CO5 | CD1, CD2, CD3, CD6, CD7 |

# COURSE INFORMATION SHEET

**Course code: EC509**
**Course title: RF Microelectronics Circuit Design**
**Pre-requisite(s): EC201 Electronic Devices, EC253 Analog Circuits**
**Co- requisite(s):**
**Credits: L: 3 T: 0 P: 0 C: 3**
**Class period per week: 03**
**Class: M. Tech.**
**Semester / Level: I/5**
**Branch: ECE**
**Name of Teacher:**

**Course Objectives:**

This course enables the students to:

| | |
|---|---|
| 1. | Understand RF frequency response of MOSFET. |
| 2. | Grasp the RF technology and basic concepts in RF design. |
| 3. | Apprehend Communication concepts and transceiver architectures. |
| 4. | Perceive Basic blocks in RF systems such as LNA, Mixer and VCO and their VLSI implementations. |
| 5. | Comprehend Radio Frequency Synthesizers and Power Amplifiers. |

**Course Outcomes:**

At the end of the course, a student should be able to:

| | |
|---|---|
| CO1 | Interpret RF frequency response of MOSFET. |
| CO2 | Articulate the RF technology and basic concepts in RF design. |
| CO3 | Explain communication concepts in transceiver architectures. |
| CO4 | Appraise basic blocks in RF systems such as LNA, Mixer and VCO |
| CO5 | Design basic blocks in RF systems such as RF Synthesizer and Power Amplifiers |

**Syllabus**
**Module I:**
**RF frequency response of MOSFET:**
Derivation and estimation of MOS capacitor, MOS capacitor in cutoff, linear and saturation region, derivation and estimation of MOSFET's long-channel model including threshold voltage, body effect, transconductance ($g_m$), output conductance ($g_{ds}$), small-signal output resistance ($r_o$), A Medium-Frequency Small-Signal Model for the Intrinsic Part, Intrinsic Transition Frequency, Noise in MOSFET: white noise, flicker noise, High frequency Small-Signal Model, Transition Frequency ($f_T$) and Maximum oscillation ($f_{max}$) of MOSFET.

(8L)

**Module II:**
**RF technology and basic concepts in RF design:**
Introduction to RF and Wireless Technology: Challenges in RF Design, Complexity Comparison, Design Bottleneck, Applications, Choice of Technology; Basic concepts in RF Design: Units in RF Design, Time Variance, Nonlinearity, Effects of nonlinearity; Noise as Random Process, effect of transfer function on noise, device Noise, Representation of Noise in Circuits. Sensitivity and Dynamic Range.

(8L)

**Module III:**
**Communication concepts and transceiver architectures:**
Analog modulation, Digital modulation, Spectral Regrowth, Mobile RF Communications, Multiple Access techniques Wireless standards; Receiver Architectures: Basic Heterodyne Receivers, Modern Heterodyne Receivers, Direct-Conversion Receivers, Image Reject Receivers, Low-IF Receivers;

Transmitter Architectures: Direct-Conversion Transmitters, Modern Direct-Conversion Transmitters, Heterodyne Transmitters.

(8L)

**Module IV:**

**Basic blocks in RF systems and their VLSI implementation:**

Low Noise Amplifier Design in various technologies, Design of Mixers at GHz frequency range; Various Mixers, their working and implementations; Oscillators: Basic topologies of VCO and definition of phase noise. Noise Power tradeoff. Resonatorless VCO design; Quadrature and single-sideband generators.

(8L)

**Module V:**

**Radio Frequency Synthesizer and Power Amplifiers:**

Radio Frequency Synthesizes: Phase Detector, Various types of PLLs, Various RF synthesizer architectures and frequency dividers; Power Amplifiers: Classification of Power Amplifiers, High-Efficiency Power Amplifiers, Linearization techniques, Design issues in integrated RF filters.

(8L)

**Text Books:**


1. John W. M. Rogers, Calvin Plett, Radio Frequency Integrated Circuit Design, Artech House, 2010.
2. Yannis Tsividis, Colin McAndrew, Operation and Modeling of MOS Transistor, Oxford University Press, 3rd edition, 2011.
3. Behzad Razavi, RF Microelectronics, 2e, Prentice Hall, 2011.


**Reference Books:**


1. Samuel Y. Liao, Microwave Devices and Circuits, 3e, Prentice-Hall of India, 2003.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Roberst G. Meyer, Analysis and Design of Analog Integrated Circuits, 5/e, Wiley, 2009.
3. The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press, 2004.


**Course Evaluation:** Individual assignment, Theory (Quiz and End semester) examinations

**Gaps in the syllabus (to meet Industry/Profession requirements):** Hands-on-practical for RF IC (Radio Frequency Integrated Circuit) fabrication.

**POs met through Gaps in the Syllabus:** PO6 will be met though RF circuit design-based assignment in a group, which involves handling of RF equipments and CAD tools.

**Topics beyond syllabus/Advanced topics/Design:** Microelectronic Circuit Designs related to Digital, Analog and Mixed-Signal (such as ADC and DAC).

**POs met through Topics beyond syllabus/Advanced topics/Design:** PO6

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

**MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 1 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO3 | 3 | 3 | 1 | 3 | 2 | 1 |
| CO4 | 2 | 2 | 2 | 2 | 3 | 2 |
| CO5 | 2 | 2 | 2 | 2 | 3 | 2 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

**MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD**

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1, CD2, CD3, CD6 |
| CO2 | CD1, CD2, CD3, CD6, CD7 |
| CO3 | CD1, CD2, CD3, CD6, CD7 |
| CO4 | CD1, CD2, CD3, CD6, CD7 |
| CO5 | CD1, CD2, CD3, CD6, CD7 |

*Open Elective*

# COURSE INFORMATION SHEET

**Course code: EC548**
**Course title: Introduction to Wireless Communication**
**Pre-requisite(s): EC 369**
**Co- requisite(s): Nil**
**Credits: L:3 T:0 P:0**
**Class schedule per week: 03**
**Class: M.Tech.**
**Semester / Level: I/05**
**Branch: ECE**

**Course Objectives:**

This course aims to develop

| | |
|---|---|
| 1 | An understanding on functioning of various example wireless communication systems, their evolution and standards. |
| 2 | An understanding on cellular communication system, architecture, functioning, various standards |
| 3 | An understanding on signal propagation in cellular environment |
| 4 | An ability to explain multiple access techniques for Wireless Communication |
| 5 | An understanding on architecture, functioning, protocols, capabilities and application of various wireless communication networks. |

**Course Outcomes**

On the completion of this course, the students will be able to:

| | |
|---|---|
| CO1 | Demonstrate an understanding on functioning of various example wireless communication systems, their evolution and standards. |
| CO2 | Demonstrate an understanding on cellular communication system, architecture, functioning, various standards |
| CO3 | Demonstrate an understanding on signal propagation in cellular environment. |
| CO4 | Demonstrate an ability explain multiple access techniques for Wireless Communication |
| CO5 | Demonstrate an understanding on architecture, functioning, protocols, capabilities and application of various wireless communication networks. |

**Syllabus**

**Module I:** An overview of wireless communication and future vision. Wireless communication system and standards: satellite communication system, GPS, paging system, cordless phone, wireless local loop, RFID (8).

**Module II:** The cellular fundamentals: cellular communication and frequency reuse, general architecture of a cellular system, channel assignment strategies, hand-off in a cellular system. Interference and cellular system capacity: co-channel interference and adjacent channel interference, power control, evolution of mobile cellular communication: different generations of mobile cellular communication (1G, 2G. 2.5G, 3G and beyond), typical cellular standards (AMPS, GSM, GPRS, WCDMA, LTE, concept of LTE-advanced), 4G features and challenges, 5G vision. (8)

**Module III:** Signal propagation in mobile communication : mobile cellular environment, multipath propagation and fading, free space propagation model, propagation path loss, outdoor propagation models (Okumura model & Hata model), indoor propagation models, power delay profile, channel parameters (delay spread, doppler spread, coherence bandwidth, coherence time, LCR and ADF). (8)

**Module IV:** Wireless Communication Networks : Wireless Personal Area Networks (Bluetooth, UWB and ZigBee), Wireless Local Area Networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), Wireless Metropolitan Area Networks (WiMAX), Ad-hoc Wireless Networks. (8)

**Module V:** Multiple access schemes: duplexing schemes, FDMA, TDMA, SDMA, spread spectrum technique and CDMA, OFDMA, ALOHA and CSMA. (8)

**Text Books:**


1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
2. Sanjay Kumar, "Wireless Communication the Fundamental and Advanced Concepts" River Publishers, Denmark, 2015 (Indian reprint).


**Reference Books:**


1. Vijay K Garg, "Wireless Communications and Networks", Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint)
2. J. Schiller, "Mobile Communication" 2/e, Pearson Education, 2012.
3. Iti Saha Misra, "Wireless Communication and Networks : 3G and Beyond", 2/e, McGraw Hill Education (india) Private Ltd, New Delhi, 2013.


**Course Evaluation:** Individual assignment, Theory (Quiz and End semester) examinations

**Gaps in the syllabus (to meet Industry/Profession requirements) :** Nil

**POs met through Gaps in the Syllabus:** N/A

**Topics beyond syllabus/Advanced topics/Design:** Current technological developments in wireless communication systems.

**POs met through Topics beyond syllabus/Advanced topics/Design:** PO3

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

**MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 3 | 3 | 2 | 1 |
| CO2 | 1 | 1 | 3 | 2 | 2 | 1 |
| CO3 | 2 | 2 | 3 | 3 | 1 | 1 |
| CO4 | 2 | 1 | 3 | 3 | 1 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO5 | 3 | 2 | 3 | 3 | 1 | 1 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

**MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD**

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD2,CD6 |
| CO2 | CD1, CD2, CD6 |
| CO3 | CD1, CD2, CD6 |
| CO4 | CD1, CD2, CD6 |
| CO5 | CD1,CD2,CD3, CD7 |

*Labs*

# COURSE INFORMATION SHEET

**Course code: EC504**
**Course title: Antenna Lab**
**Pre-requisite(s): EC257 Electromagnetic Fields and Waves , EC323 Microwave Theory &Techniques**
**Co- requisite(s):**
**Credits: L:0 T:0 P:3**
**Class schedule per week: 03**
**Class: M.Tech.**
**Semester / Level: I/05**
**Branch: ECE**

**Course Objectives**

This course enables the students:

| | |
|---|---|
| A. | To understand important and fundamental antenna engineering parameters. |
| B. | To develop the basic skills to learn software and apply in the design of various antennas. |
| C. | To develop the basic skills necessary to measure antenna performance parameters. |
| D. | To apply the concepts learnt through theory |
| E | Develop the ability to analyze the performance parameters of different types of antenna |

**Course Outcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| 1. | Have the ability to implement the theoretical knowledge and prepare the reports and present the results. |
| 2. | Apply numerical modelling tools (software) to design antennas, with particular reference to low profile printed antennas. |
| 3. | Have the ability to perform antenna measurements. |
| 4. | Understand and visualize the radiation characteristics and its limitations and provide the environment friendly solutions in terms of antenna design. |
| 5 | Have the ability to Practically verify different microwave antenna theories . |

**List of Experiments**

1. Design of a rectangular microstrip patch antenna for operating frequency 1.88GHz with $\varepsilon_r$ =4.4,h=31 mils with inset feed. (IE3D)

2. Design of a rectangular microstrip patch antenna for operating frequency 1.88GHz with $\varepsilon r$ =4.4, h=31 mils with coaxial feed. (IE3D)

3. Design of a rectangular microstrip patch antenna for operating frequency 5 GHz with Ɛr =3.2, h=0.762mm & transformer coupled microstrip feed. (IE3D)

4. Design of a circular microstrip patch antenna for circular polarization with dual feed. Assume resonant frequency =2.78GHz,Ɛr =2.33,h=2.184mm, tanδ=0.0012. (IE3D)

5. Design of a rectangular microstrip patch antenna for operating frequency 1.88GHz with Ɛr =4.4, h=31 mils & inset feed. (HFSS)

6. Design of a rectangular microstrip patch antenna for operating frequency 1.88GHz with $\varepsilon_r$ =4.4, h=31 mils & transformer coupled microstrip feed. (HFSS)

7. To plot the radiation pattern of a directional antenna.
8. To plot the radiation pattern of an omnidirectional antenna.

9. To calculate the resonant frequency and estimate the VSWR of an antenna.

10. To prove inverse square law for any antenna..

11. Characterization of a linearly polarized and circularly polarized antenna.

12. The gain measurement of an antenna under test.

**Course Evaluation:** Progressive Evaluation and End-Sem. Evaluation

**Gaps in the syllabus (to meet Industry/Profession requirements) :**

**Topics beyond syllabus/Advanced topics/Design:**

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

## MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 3 | 3 | 2 | 3 |
| **CO2** | 2 | 3 | 3 | 3 | 2 | 3 |
| **CO3** | 2 | 3 | 3 | 3 | 2 | 3 |
| **CO4** | 2 | 3 | 3 | 3 | 2 | 3 |
| **CO5** | 2 | 3 | 3 | 3 | 2 | 3 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

## MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD3 |
| CO2 | CD3 |
| CO3 | CD5,CD3 |
| CO4 | CD5,CD3,CD7 |
| CO5 | CD3,CD7 |

# COURSE INFORMATION SHEET

**Course code: EC511**
**Course title: Wireless Communication Lab**
**Pre-requisite(s): EC 510**
**Co- requisite(s): Nil**
**Credits: L:0 T:0 P:3**
**Class schedule per week: 03**
**Class: M.Tech.**
**Semester / Level: I/05**
**Branch: ECE**

**Course Objectives**

This course aims to develop ability to:

| | |
|---|---|
| 1 | Evaluate the impact of different propagation conditions in estimation of received signal power. |
| 2 | Configure different wireless communication systems and evaluate their functioning, establishing LTE and MIMO system for two way communication. |
| 3 | Find geographical position using survey plotting with the help of GPS system |
| 4 | Design micro strip patch antenna using suitable parameters |
| 5 | Analyse different protocols of WLAN System |

**Course Outcomes**

On the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Evaluate the impact of different propagation conditions in estimation of received signal power. |
| CO2 | Configure different wireless communication systems and evaluate their functioning, establishing LTE and MIMO system for two way communication. |
| CO3 | Find geographical position using survey plotting with the help of GPS system |
| CO4 | Design micro strip patch antenna using suitable parameters |
| CO5 | Analyse different protocols of WLAN System |

**Syllabus**

**List of Experiments**

1. Evaluate the impact of path loss and shadowing in estimation of received signal power in mobile cellular communication using fading channel mobile communication virtual lab.

2. Calculate the boundary coverage probability in a cellular system using fading channel mobile communication virtual lab.

3. Demonstrate the impact the received power levels for hand-off in case of mobile cellular communication using fading channel mobile communication virtual lab.

4. Estimate the impact of sectoring in increasing cellular system capacity using fading channel mobile communication virtual lab.

5. Examine the impact of co-channel interference on the value of SIR in mobile cellular communication using fading channel mobile communication virtual lab.

6. Setting up of LTE 2x2 MIMO system for establishing two way communication.

7. Study of pure ALOHA and slotted ALOHA protocols for WLAN System.

8. Configure ZigBee module as an end device and, set up a communication link with two ZigBee modules.

9. Study of RFID system and its applications.

10. Using IE3D, design a rectangular micro strip patch antenna for inset feed for operating frequency of 1.88 GHz, relative permittivity of 4.4 and length of 31 mils.

11. Using GPS system, study the graphical representation of geographical position using Survey plotting.

12. Study the PN sequence and examine Gold code with variable sequence length and analyze its correlation. Also set up voice communication using DSSS scheme using CDMA trainer kit (ST-2131-A).

**Optional Experiments**

1. Study the GPRS system and use it for sending an e-mail through WI-GPRS trainer.

2. Study the GSM modem and its different module for phone book, setting up a call, sending SMS and identifying call history using AT commands.

3. Interfacing of GSM modem with control unit.

4. Design a patch antenna using IE3D using different parameters.

**Text Book:**

1. Vijay K. Garg, “Wireless Communications and Networks”, Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint).

**Reference Books:**

1. Simon Haykin, “Communication Systems”, Wiley Eastern Limited, New Delhi, 2016, 4/e.
2. J. Schiller, “Mobile Communication” 2/e, Pearson Education, 2012.

**Course Evaluation:** Individual experiments, Quiz and performance evaluation

**Gaps in the syllabus (to meet Industry/Profession requirements) :** Nil

**POs met through Gaps in the Syllabus:** N/A

**Topics beyond syllabus/Advanced topics/Design:** Experiments related to Software Defined Radio will be included.

**POs met through Topics beyond syllabus/Advanced topics/Design:** PO4

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Assignments/Seminars |

| | |
|---|---|
| CD3 | Laboratory experiments/teaching aids |
| CD4 | Industrial/guest lectures |
| CD5 | Industrial visits/in-plant training |
| CD6 | Self- learning such as use of NPTEL materials and internets |
| CD7 | Simulation |

## MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 3 | 3 | 1 | 1 |
| CO2 | 2 | 1 | 3 | 2 | 2 | 1 |
| CO3 | 1 | 1 | 3 | 1 | 1 | 1 |
| CO4 | 3 | 1 | 3 | 2 | 1 | 1 |
| CO5 | 2 | 1 | 3 | 2 | 1 | 1 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

## MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD3, CD, CD7 |
| CO2 | CD3, CD, CD7 |
| CO3 | CD3, CD, CD7 |
| CO4 | CD3, CD, CD7 |
| CO5 | CD3, CD, CD7 |